

LIFE HISTORIES OF CENTRAL AMERICAN PIGEONS

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IN the last 35 years, I have found nests of 15 of the 25 species of pigeons and doves resident in Central America. Whenever these nests were conveniently situated and other occupations permitted, I tried to learn something about them; but most of the studies that I began were prematurely ended by the loss of nests to predators. In the cases of three species whose nests were available in fair numbers, the Ruddy Quail-Dove (*Geotrygon montana*), the Ruddy Ground-Dove (*Columbigallina talpacoti*), and the Blue Ground-Dove (*Claravis pretiosa*), I succeeded in following all stages of the breeding operations, and reports of these studies have already been published (Skutch, 1949, 1956, 1959). For another species, the White-tipped or White-fronted Dove (*Leptotila verreauxi*), I have extended but less complete observations, which are presented in this paper. On the remaining species my observations are more fragmentary, sometimes restricted to a single phase of the breeding cycle, such as nest building or incubation, or in some cases to the description of the nest and eggs. In aggregate, however, this material permits us to sketch in at least rough outline the biology of the Central American representatives of the Columbidae, on whose habits very little has been published. In this paper I shall first present my hitherto unpublished observations, species by species, and in the concluding section I shall attempt to draw such generalizations as seem to be warranted by the available information. In this summary I shall draw upon observations contained in the above-mentioned published papers.

As an example of the number of species of pigeons which may be found in a single locality in Central America, I may add that on our farm of about 250 acres (102 hectares) at El Quizarrá in the valley of El General, Costa Rica, around 2,500 feet above sea level, the following seven species are resident and have been found nesting: Scaled Pigeon (*Columba speciosa*), Short-billed Pigeon (*C. nigrirostris*), Ruddy Ground-Dove, Blue Ground-Dove, White-fronted Dove, Rufous-naped Gray-chested Dove (*Leptotila cassinii rufinucha*), and Ruddy Quail-Dove.

SCALED PIGEON

Although not lacking in beauty, the pigeons of the Western Hemisphere cannot vie in splendor and ornateness of plumage with some of those of the islands of the southwestern Pacific and neighboring regions. One of the most beautiful of the American representatives of its family, the male Scaled Pigeon (*Columba speciosa*) is clad in rich shades of chestnut and brown, glossed on the neck with purple and green, with crowded, scale-like markings of black and white or cinnamon-rufous on the neck, upper back, and breast. The

female's colors are paler. Although individuals from the same region exhibit considerable diversity in plumage, throughout its vast range from southern Mexico to Paraguay the species is so uniform that no geographical races are recognized. An inhabitant of the wooded lowlands of continental America, this large pigeon ranges upward to at least 4,000 feet in southern Costa Rica, 5,000 feet in western Panama (Ridgway, 1916:319) and the Santa Marta region of Colombia (Todd and Carriker, 1922:197), and 3,500 feet in British Guiana (Ridgway, loc. cit.).

Todd and Carriker (loc. cit.) mention a flock of not less than a hundred Scaled Pigeons which in early November had gone to roost in scrub on a hillside at an altitude of about 1,500 feet in the Santa Marta region, but such concentrations appear to be rare even there. In northeastern Venezuela this pigeon was found in small flocks of less than ten individuals, always in the rather heavy woods of the "quebradas" which cut back into the savanna of the mesa (Friedmann and Smith, 1955:492). But in the valley of El General and neighboring areas, which seems to be the only part of Costa Rica where the Scaled Pigeon is somewhat common, I have met it singly or in pairs, never in flocks. Here one most often sees the handsome bird perching conspicuously on a dead limb at the very top of a tall tree at the forest's edge, with the sky as its background, or flying swiftly and directly across a clearing, high overhead. It seems to subsist on small fruits which it finds high in the trees, and I have not seen it on the ground.

Voice.—The Scaled Pigeon's call, heard chiefly in the dry season and early part of the wet season—from January to April or May—is a deep, full, far-carrying *cooo*. Comparing this booming sound to the lowing of distant cattle, Friedmann and Smith state that in northeastern Venezuela it has earned for the bird the appellation "paloma tora" (bull pigeon). In El General, however, it is called "paloma morada" (purple pigeon).

Nest and eggs.—Strangely enough, in El General this pigeon which spends most of its life high in the giant trees of the rain forest often chooses to nest near the ground, in secondary vegetation. I have frequently watched a solitary bird struggle to break a twig from a high dead branch at the forest's edge, then fly down into a neighboring second-growth thicket with its single piece. Sometimes the pigeon has traveled over the low, tangled growth for 200 or 300 yards before vanishing amid the foliage, where doubtless its mate was waiting to receive the contribution and arrange it in the growing nest. But the almost impenetrable density of the rank intervening vegetation, often a 2 or 3 years' growth on a resting grain field, discouraged the attempt to find the nest by following the flight of the building pigeon.

Over the years, however, I have discovered ten of these nests in El General, between 2,500 and 3,000 feet above sea level. Two of the nests were situated

at a height of 15 feet on sotacaballo trees (*Pithecolobium* sp.) growing on the shore of the broad, rushing Río Buena Vista. One was far out on a lower branch, the other in a tangle of vines that had overgrown the tree. Possibly in former times most of the Scaled Pigeons' nests were placed in such streamside vegetation, but since the recent extensive destruction of the forest in this region, many have taken to building in the low, second-growth thickets that soon cover abandoned croplands and neglected pastures. Of the eight nests not beside a river, five were built at heights ranging from 7 to 15 feet in tangles of vines that had grown over bushes and small trees in second-growth thickets. One nest was lower and more exposed, only 2 feet above the ground on the leaning stalks of a cluster of bracken fern (*Pteridium aquilinum*), in a bushy field from which maize had been harvested only 7 months earlier. The last two nests that I have found were in very different situations, about 50 and 60 feet up in the tops of trees so densely covered with lianas that the nests were hardly visible from the ground. Both of these nests were in a small grove of secondary woods between coffee plantations and about 600 feet from the nearest forest, whence the material for building at least one of them was carried across an intervening pasture. These nests were found in 1960 and 1963, and both may have belonged to the same pair of pigeons.

The accessible nests were broad, slightly concave platforms composed of fine sticks and branched dry inflorescences, in one instance of the burío tree (*Heliconia excelsior*). Nearly always thin, some of the nests were so slightly constructed as to be hardly more than a latticework for supporting the egg. In one nest, the largest stick measured 10 inches in length by $\frac{3}{16}$ inch in diameter at its thicker end.

Five of these nests contained each a single white egg, and three held solitary nestlings. The earliest nest had an egg on 21 February 1937, and the latest of the accessible nests held an egg on 22 May 1936. A pair of doves were found building on 29 July 1963, but I could not learn whether an egg was laid in this high nest, invisible amid a tangle of vines. Although I found no nest with two eggs, Belcher and Smooker (1936) reported two sets of two from Trinidad, where a number of species of birds occasionally or regularly produce larger sets than I ever discovered in Costa Rica. In other respects, too, the Scaled Pigeons of Trinidad differ in their breeding habits from those in El General. The nests described by these authors were fairly substantial platforms of twigs, from 30 to 40 feet up in smallish trees in the forest. Their eggs measured 39 by 29.9, 39.6 by 29.8, 40 by 29.8, and 37.4 by 29.1 mm.

The nestling.—The nestling Scaled Pigeon has a number of behavior patterns which appear to serve for its defense. When a young pigeon in pinfeathers is disturbed, it rises in the nest, stretches up its neck, puffs out its breast, and lifts its wings, all of which make it look much bigger than it did while resting quietly. In

this attitude it sways upward and backward, downward and forward, with each forward and downward movement making with its bill a low clicking or clacking sound. As long as it feels itself menaced, the nestling continues to perform rhythmically in this fashion. The *clack* is produced by the mandibles in a peculiar manner. The lower mandible is pushed slightly forward until its apex rests against the downwardly bent tip of the upper mandible. The bill is then slightly open. Apparently the two mandibles are pressed together by muscular tension until the lower one suddenly slips back into its normal position; and the two, striking together along their entire length, emit the sharp sound. The nestling also darts forward to peck an intruding hand with its bill; and, after its feathers begin to expand, it strikes with its wings. Taken in hand, it struggles vigorously without ceasing to clack its bill, and at the same time it hisses slightly. Doubtless all this belligerent display intimidates small animals, yet some nestlings are taken by predators.

For the first week or so after the nestling hatches, the parents remove its droppings and keep the frail platform clean, although the empty shell may be left there for some days. But later the adults relax their attention to sanitation, with the result that a nest from which the youngster has just flown is foul with excrement. I do not know the length of the nestling period, but one nestling which appeared to be only a few days old when first found was 2 weeks later resting a yard from its nest, well clothed with feathers. It watched me come close, then took wing and flew well. Its plumage was a rich shade of brown, but lacked the light spots which impart a scaled appearance to the adults.

SHORT-BILLED PIGEON

The rather small, brownish Short-billed Pigeon (*Columba nigrirostris*) is confined to the more humid forested lowlands of southern Mexico and Central America, including western and central Panama. At higher altitudes it is replaced by the Ruddy Pigeon (*C. subvinacea*), and the similarity in plumage, in the colors of bill, eyes, and feet, and even in voice of these two species makes it difficult to learn how far upward *C. nigrirostris* ranges, or how far downward the related form extends. There appears, moreover, to be a considerable vertical overlap in their ranges. The numerous published records of specimens are not as helpful in working out this problem as they might be, because the citations usually give the locality rather than the altitude at which the collection was made, and in mountainous regions specimens from a named locality may come from points with a vertical separation of a thousand feet or more. In the lower parts of the basin of El General, where most of my observations were made, the Short-billed Pigeon, distinguished from its congener by the duller, more olive hue of its brown back, is the resident form.

I have found Short-billed Pigeons in pairs throughout the year. They live

chiefly in the upper levels of the rain forest but often enter neighboring clearings to forage. Here they are attracted by the small green berries of the mistletoes which often heavily parasitize the scattered trees, and while eating they sometimes permit one to approach close enough to distinguish their black bills, bright red eyes, and coral red feet. They descend almost to the ground to eat the berries of the pokeberry (*Phytolacca rivinoides*) which springs up profusely on the scorched ground of newly made clearings from which the crop of maize has been harvested. Once I saw a pair of these pigeons alight on a sandy patch of shore beside a mountain torrent, where evidently they picked up gravel or possibly small invertebrates.

Voice.—The far-carrying, melodious, tetrasyllabic call of this pigeon, heard chiefly in the dry season and the first months after the rains return, is one of the characteristic and memorable sounds of the lowland forests of Central America. Years ago, I learned from Frank M. Chapman to paraphrase it *O, je t'adore* and, whenever heard, it naturally brings these words into my mind. But the boys who used to carry my portfolio for collecting plants in El General gave the pigeon's call the less romantic rendering *Tres tontos son* (They are three fools), and these words suggest the call almost equally well. Eisenmann's (1952:21) notation *ho, cu-cu-coóoo* is perhaps more accurate but less easy to remember. The only difference that I could detect between the song of this pigeon and that of the Ruddy Pigeon of the mossy, epiphyte-burdened subtropical forests is that the latter is somewhat less soft and liquid.

Nest building.—Early in the morning of 21 March 1944, I watched a Short-billed Pigeon break pieces from old inflorescences of a burío tree that stood in tall second-growth woods, about 100 yards from the nearest primary forest. To detach a part of the many-branched dry panicle was strenuous labor, and sometimes the bird tugged at branch after branch before he found one that yielded to his effort. Having procured a branching piece of the inflorescence, he flew down into a dense tangle of vines, shaded by taller trees, at a point about 25 feet above the ground. After much moving through the resisting undergrowth, I found a spot whence I could glimpse this pigeon's mate, who sat amid the vines, received the pieces which the other brought, and worked them into what obviously was the foundation of a nest. In the course of 2 hours, the active partner took to the other at least 17 contributions, but never more than one branching piece on a journey, as far as I could see. It seemed that sometimes he stood on the other's back while he delivered it, but obstructing vegetation did not permit a clear view of the transaction. The partner who took charge of arranging the material remained on the nest continuously throughout the 2 hours that I watched. At the end of this interval, I was forcing my way rather noisily through the undergrowth toward the neighboring road, when the member of the pair who had been fetching material began to call *O, je t'adore*, while the mate answered from

the nest with a throaty, growling note. This strengthened my conclusion that the more active partner was the male, as in a number of other pigeons and doves of which the sexes differ in appearance.

On 10 August 1945. I watched a Short-billed Pigeon break twiglets from a dead branch at the top of a small tree in the forest. He had chosen a cacique, a tree of the myrtle family which has very tough wood, and he struggled hard to detach pieces, trying one twig after another, and sometimes hanging head downward with spread wings while he threw all his weight against it. He continued with indomitable persistence until he secured a fragment of the branch, which he then promptly carried up to the crown of a tall palo de vaca or milk tree (*Brosimum utile*) that grew close by, into the midst of which he vanished. Soon he returned to the same dead branch for another twiglet. Several that were easily broken off were dropped, but at last a satisfactory one was secured and borne up into the same great tree. Here, somewhere about 100 feet above the ground, his mate was evidently sitting to receive and arrange the materials which he continued to bring to her, but she was perfectly concealed amid the heavy masses of foliage into which the pigeon disappeared each time.

Nests placed so high as those of the Short-billed Pigeon, amid such dense foliage, are not often found after completion, when the parents' visits to them are far less frequent. I am aware of no record of the eggs of this species.

PALE-VENTED PIGEON

The Pale-vented Pigeon (*Columba cayennensis*) is a large species with light-colored, purple-tinged plumage, ranging from southern Mexico to Brazil and Paraguay. A lowland bird, it is reported by Carriker (1910:394) to occur at 4,000 and even 5,000 feet in the Central Plateau of Costa Rica, but it is certainly rare at such high elevations. Although it is present in the lower reaches of the Térraba Valley, I have not once met it in El General, the mountain-rimmed basin at the head of the same valley, lying chiefly above 2,000 feet. Absent from the generally arid Pacific side of northern Central America, it is the most abundant large pigeon of the deforested and open parts of the Caribbean side, from Guatemala to Panama, and upward to 2,000 feet. It is found chiefly where there are more or less isolated large trees, as in pastures, plantations, marshy areas, and along rivers, and it usually rests on the higher branches. Once in June I found a flock of 14 perching in a tree in a pasture, but usually I have seen smaller groups or single individuals. These pigeons eat the small black berries of *Conostegia*, a shrub of the melastome family, and doubtless a variety of other fruits. Cherrie (1916:351) states that they subsist almost exclusively on fruits. Their call is resonant and stirring, *Woo co-co-co cooo*, repeated over and over. Sometimes in March they engage in angry fights, slapping each other with resounding blows of their wings.

Nest and eggs.—I found two nests on Alsacia Plantation, in the first hills which rise up on the eastern side of the Motagua Valley opposite Quiriguá, Guatemala. They were in low shrubs in pastures, at heights of 3.5 and 4 feet, well hidden by foliage. In the case of the lower nest, a vine had overgrown the bush and added to the density of the leafy screen. The nest, composed of branched inflorescence stalks of some unidentified plant, was a frail, shallow saucer, or merely a slightly concave platform. The more deeply cupped of these two nests was about 6 inches in diameter by 1.5 inches in depth. Each nest contained a single pure white egg, measuring respectively 34.9 by 25.4 and 36.5 by 26.6 mm. These eggs were found on 9 April and 8 May 1932.

In the Orinoco region of Venezuela, Cherrie (1916:351) found Pale-vented Pigeons nesting in moriche palms, in tangled thickets in and around marshy places, and in the scrub oaks scattered over the savannas. The slight platforms of dead twigs were placed from 2 to 5 meters above the ground, and each contained a single egg. Belcher and Smooker (1936) state that on the islands of Trinidad and Tobago this pigeon builds its frail structures of twigs from within hand reach to 15 feet up. They found nests from 20 February to 23 May, and each contained a single egg or young bird. Eisenmann (1957:252) reported that where they are not persecuted the Pale-vented Pigeons nest in suburban gardens, but he gave no details.

RED-BILLED PIGEON

When viewed in full sunlight, the prevailing deep vinaceous purple of the Red-billed Pigeon (*Columba flavirostris*), contrasting with the bluish gray of its rump and upper tail coverts, makes it outstandingly beautiful. At least as applied to the Costa Rican race, the Latin *flavirostris* is more accurately descriptive than the English "Red-billed," for in the field the bill appears pale yellow rather than red. This species ranges from Texas to central Costa Rica. In the north it inhabits more or less arid country, mainly below 3,500 feet. But at the southern extremity of its range the race *minima* is distributed from the semiarid lowlands of Guanacaste to the Central Plateau of Costa Rica and surrounding mountains, up to about 7,000 feet above sea level. It has even become established in clearings in the heavy rain forest on the wet Caribbean slope. On the excessively wet northern side of the Cordillera Central, I did not find this pigeon between July and March, but at the end of this month a pair arrived in the clearing in the heavy, subtropical forest where I dwelt. These pigeons perch high in the trees, singly, in pairs, or rarely in larger groups. Their song is loud, deep-toned, and far-carrying: *Woooo, c'c'coo, c'c'coo, c'c'coo*. A shorter version consists of a long-drawn, sonorous, ascending note followed by three shorter notes: *Cooo cu cu coo*.

Nest and eggs.—In the valley of the Río Pejivalle on the Caribbean slope of

Costa Rica at an altitude of about 2,100 feet, I found a pair building a nest on 15 April 1941. Their site was about 80 feet up in a crotch of a tall dead tree standing beside a stream that flowed through pastures. Here it was above the foliage of all the surrounding streamside trees, but well screened by the ferns, bromeliads, and other epiphytes that grew on the dead tree. At 0848 one member of the pair went to the nest with nothing in its bill, then promptly left, perched on the end of a dead branch, and called with deep, resonant notes, which soon drew its mate. The first pigeon then flew up beside the newcomer and crouched, and after a while the latter acceded to this invitation and mounted it. Presently they reversed roles, the one who had been below mounting the one who had been on top. Thus, to my regret, I could not distinguish the sexes by their positions in coition. Soon they proceeded to build. While one member of the pair sat continuously on the nest, the other made five trips, each time bringing a single good-sized twig and delivering it to the stationary partner for arrangement in the structure.

In this same locality, a week later, I noticed another pair building high up in a clump of thorny pejibaye palms (*Guilielma utilis*) growing in a field of sugarcane on a hillside. Screened by the clustered, plume-like fronds, the nest was wholly invisible from the ground.

The other seven nests of which I have records were found from 1937 to 1954 on the Hacienda Las Cónnavas, a few miles east of Cartago, Costa Rica, at an altitude of about 4,500 feet. Here the breeding season is long, for one pair seemed to be incubating as early as 26 March 1952, while in other years eggs were present as late as mid-August. One nest was in a *Callistemon* tree in the garden, one in a young cypress (*Cupressus Benthamii*) in a hedgerow, and the remaining five in a long, narrow plantation of half-grown cypresses in the midst of open pastures. This dense planting was a favorite site, and here I discovered three nests on 28 June 1937, while two were present on 14 August of the following year. The nests in the young cypress trees were built on slender, horizontal branches at heights ranging from 7 to 15 feet above the ground, whereas that in the garden was 25 feet up. These nests, made of coarse sticks, were thin, frail platforms, which in one instance measured 7 by 9 inches in diameter. There was never more than one egg or nestling in a nest, and this is the number which the Red-billed Pigeon lays in the northern parts of its range. The eggs were pure white, and one measured 40.5 by 26.6 mm.

Care of the young.—Nests with still unfeathered nestlings were perfectly clean, although there were sometimes a few droppings, probably of the parents, beside them on the supporting branch. But when older, feathered nestlings were present, the nest was heavily soiled around the edges, although clean in the center. From this it is evident that parent Red-billed Pigeons, like parent Scaled Pigeons, attend to the sanitation of the nest while their nestlings are young

but neglect this when they are older. When disturbed, feathered nestlings rise up, stretch out the neck, and make a clacking sound with the bill, not so loud as that produced by the young Scaled Pigeon. They strike and bite intruding fingers, but not with force sufficient to cause pain.

The parent Red-billed Pigeons were most attentive, and on several visits I found one of them brooding, or at least resting beside, a well-feathered nestling. The situation of the nests in the cypress plantation surrounded by broad open fields was favorable for distraction displays, and these parents made the most of it. While brooding they allowed me to come very close, and sometimes it was necessary to shake their tree in order to make them go and reveal what they were covering. On leaving the nest, they fluttered across the open pasture, beating their wings loosely as though scarcely able to fly, yet skimming over the short grass at a good speed. Thus they led me for 100 feet or more, until they reached a bush or low tree, in which they alighted, and there continued to flap their wings in a loose and apparently uncoordinated fashion, while they watched my advance. When I came closer than they deemed safe, they dropped down and again flew low over the pasture until they came to the next bush that provided a limb for perching, and here they paused and fluttered their wings as before. At times they would make still a third fluttering flight, before at last they flew off in their normal way, leaving me several hundred yards from the nest where I had disturbed them. A parent of a feathered nestling, after having lured me away in this fashion, returned while I was examining its nest 10 or 15 minutes later, perched on the top of a neighboring cypress tree, and flapped its wings loosely as it had done while luring me off in the first place.

A still more spectacular performance was given one day when a dog followed me into the cypress plantation. At my approach, a pigeon dropped from beside its feathered nestling almost to the ground. As it descended, the dog jumped toward it, and to save itself the bird had to flee more rapidly than it could do while fluttering over the ground in the usual distraction display. But it flew slowly, only a foot or so above the grass, and led on the dog, who continued to follow with high hope of catching the pigeon, until the two had passed over the boss of the hillside and were beyond view.

BAND-TAILED PIGEON

The large, grayish Band-tailed Pigeon (*Columba fasciata*) is easily recognized by the conspicuous white crescent on its nape and the dark band across the middle of its gray tail, the apical half of which is more whitish than the remainder. It occurs from southwestern British Columbia through Mexico and Central America to Peru, Bolivia, and British Guiana. Although in the northernmost portion of this vast range it is found at low altitudes, elsewhere it is an inhabitant of the highlands, in Arizona, for example, nesting above 7,000 feet,

and in New Mexico extending as high as 11,000 feet (Ridgway, 1916:219). In Guatemala the nominate race is found chiefly between 5,000 and 10,000 feet, although it occasionally descends as low as 2,400 feet (Land, 1963:52). In Costa Rica the race *C. fasciata albilinea* (which is sometimes considered to be a separate species) inhabits the high mountains, chiefly between 7,000 and 11,000 feet, although at times it descends lower in search of food (Carriker, 1910:394). In South America the situation is similar: in the Santa Marta region of Colombia, Todd and Carriker (1922:193) noted the presence of the Band-tailed Pigeon in the Subtropical and lower part of the Temperate Zone, from 5,000 to 10,000 feet; while in the Cordillera de la Costa of Venezuela, Schäfer and Phelps (1954:52) recorded its occurrence in the Subtemperate belt between 2,000 and 2,400 meters (6,562 to 7,874 feet).

In northern Central America, Band-tailed Pigeons live chiefly in the zone of mixed woodlands, where pines grow amid oaks and other broad-leaved trees, but occasionally they are found about the edges of the forests of great cypress trees on the high mountaintops. In southern Central America, where native conifers (except *Podocarpus*) are absent, they are associated with the oak trees so abundant in the forest above 4,000 or 5,000 feet. I have met them flying singly, or a few together, or in large, compact flocks. They rest high in tall trees, often on the topmost twig of a lofty pine or cypress, where from afar their stout bodies are visible, standing against the sky in statuesque immobility. On taking flight they often make a loud, slapping noise with their wings, in the manner of other large pigeons. In regions somewhat accessible to men, they are much persecuted and very wary.

Food.—In Central America, Band-tailed Pigeons subsist on a variety of small fruits, often descending almost to the ground to gather those of a low shrub. In Guatemala I watched them eating the berries of mistletoes, and surprised them in fruiting bushes of *Fuchsia arborescens* and a species of *Cestrum*; but they were too wary to continue eating the small black berries of the first, or the white berries of the second, while I watched them. While walking over the open summit of the Cerro de las Vueltas in the Talamancan range of Costa Rica in March 1936, I saw hundreds of these pigeons, which had been attracted by the small fruits of a bushy pokeberry (*Phytolacca*) that flourished there.

Band-tailed Pigeons are very fond of acorns, which in season appear to be their principal food. At the end of September 1933, when the abundant oak trees on the Sierra de Tecpam in Guatemala were laden with ripening acorns, flocks of Band-tailed Pigeons settled in the treetops and tried prematurely to pluck them. Perching precariously near the ends of the twigs, they grasped the acorns in their bills, making strenuous but, as far as I could see, always unsuccessful attempts to detach them. In trying to pull the acorns from their cups,

the heavy birds often lost their balance and went with a loud flapping of wings to another perch. A party of a score or more caused a great commotion in the treetops. Six weeks later, when the ground was littered with fallen mast of the oaks, the pigeons still gathered them from the treetops, where they stood far out on the twigs, plucked the acorns from their sockets, and swallowed them whole. Now that the fruits were so easily detached, the birds foraged in silence, and I might pass beneath a tree where a dozen were feasting without becoming aware of them until, alarmed by my presence, they noisily took wing.

Voice.—In Guatemala, the deep mellow notes of the Band-tailed Pigeon sounded to me like *C'cooo c'cooo*. Sometimes in flight, in addition to their loud wingbeats, they produced a low, rattling sound, which apparently issued from their throats.

Bathing.—On the northern slope of Volcán Irazú, at an altitude of about 5,500 feet, we found several Band-tails near a stream of hot water that welled out of the mountainside in a pasture. My companion, Dr. Roderich Graf Thun, told me that he had seen the pigeons bathing here.

Nest and eggs.—The single Band-tailed Pigeon's nest that I have seen was situated in a young pine tree on a bushy mountain slope above Tecpam, Guatemala, at an altitude of about 9,000 feet. The loosely constructed platform of coarse sticks, about 8 by 7 inches in diameter, rested on a nearly horizontal branch, in contact with the main trunk, 20 feet above the ground. When found on 13 March 1933, this nest contained a single white egg, which was almost equally blunt on the two ends and measured 42.9 by 28.6 mm. No other egg was laid in the following days. In the United States, this race of the Band-tailed Pigeon also as a rule lays a single egg, although sets of two are sometimes produced. But in the only nest of the southern race *albilinea* of which I have found a record, two eggs were present. This nest, at an altitude of about 7,500 feet in the Santa Marta region of Colombia, was placed about 10 feet from the ground in a small tree and its eggs were creamy white (Todd and Carriker, 1922:198).

Incubation.—I spent the whole of one day and parts of three other days watching the parents attend their egg in the pine tree. On 19 March, I began my vigil at 0550, while it was still too dark to distinguish the nest. As the light increased, the female, who was covering the egg, became increasingly restless, until, at 0620, she flew away. But after an absence of only a minute she returned and sat quietly until her mate came to replace her at 0823. He then incubated without interruption until the female came back at 1557 in the afternoon. She sat steadily until, at 1840 hours, I could no longer see her amid the pine needles and I left. At 0550 the next morning I reentered the blind, and when there was sufficient light I saw that the female was still at her post. At 0613 she took an outing that lasted only about a minute, then sat until her mate relieved her at

0831. On 17 March he was already present when I began to watch at 0900 hours, and he covered the egg continuously until the female arrived at 1600 in the afternoon. On 18 March, the male was present at 0840 in the morning, and in the afternoon I watched the female replace him at 1530. Then she remained until nightfall.

These pigeons, then, incubated on a very simple schedule, well adapted to a bird able to sit quietly for long periods without eating. The female went to the nest between 1530 and 1600 in the afternoon, and if undisturbed she sat continuously until soon after 0600 the following morning, when she went off for about 1 minute, probably to stretch her wings and avoid soiling the nest; for she was not absent long enough to find food. Returning, she remained on the nest until, between 0815 and 0830 hours, the male came to take charge of the egg. He sat without a break for from 7 to 8 hours, until his mate returned in the afternoon. If the pigeons were not disturbed, their eggs were left exposed for less than 2 minutes in the course of a day. At a nest of the Band-tailed Pigeon watched by Peeters (1962) in California, the male did not come to cover the eggs until after 1000. The female also came late in the afternoon, usually after 1700.

The changeover was effected without ceremony. The newcomer flew up into the pine tree with no sound except the loud wing flaps which broke its momentum as it lighted on a branch at a distance from the nest. Then the partner on the egg stretched up its neck, slowly and deliberately arose, walked out along the supporting branch, and when in a clear space noisily beat its wings as it launched itself into the air. Neither bird gave any greeting or sign of recognition to the other. After the departure of its mate, the new arrival flew to the supporting branch, walked along it to the nest, and settled down on the egg. At first it held its neck upstretched and looked around, as though to assure itself that no enemy lurked near, but if it sighted nothing alarming its neck gradually sank down between its shoulders. Then it shifted to a more comfortable position, perhaps turned the egg, and was ready for a long period of continuous sitting.

Often one's attention is drawn to the nest of a pigeon or dove by its loud, abrupt flight as he unwittingly approaches. The bird's swift departure gives the impression that it burst wildly from the nest, and one wonders that the egg was not thrown from the shallow receptacle by this sudden movement. But long watching from concealment corrects the impression that pigeons are stupid birds who jeopardize their eggs by panicky departures. The Band-tailed Pigeons in the pine tree were very reposeful, sat for long intervals without shifting their position, and rarely turned their egg. The male rotated on the nest and stretched his wings even less than the female. When perfectly at ease, each kept its head between its shoulders, turned to the left. Distant noises were usually disregarded

by the sitting bird, except when very loud and sharp. Sounds from a nearer source caused it to stretch up its head and look around. If the noises became more alarming, the pigeon rose in the nest and prepared to flee. But if the approaching animal proved to be only a horse or a cow, snorting or treading on dry sticks which snapped loudly, the bird settled down again, then slowly, very slowly, its neck contracted and its head turned leftward. Thrice, while I watched, men hunting cattle or firewood passed beneath the nest without frightening away the incubating pigeon, who lifted its head, took in the situation, and decided to risk remaining.

These pigeons seemed to know that their departure in the presence of an intruder would reveal their nest's position. I admired the cool judgment, the careful weighing of risks, that kept them at their post to the last moment compatible with their own safety, and indirectly that of their offspring, which could not survive without them. I believe that only a very sudden fright could make a pigeon take wing without first stepping from its nest, which might be damaged by taking off directly from it, as a hummingbird does. The loud wingbeats, which give the impression of immoderate haste, are the necessary accompaniment of a heavy bird's launching itself into the air, and are not indicative of a panic-stricken departure.

A few days after I completed my study of incubation, the egg vanished from the nest in the pine tree. Fortunately, Neff and Niedrach (1946) provide details of the care and development of a nestling in Colorado. For 20 days after it hatched, the parents brooded it almost continuously, leaving the nest only rarely for short periods, up to 30 minutes, to drive away an intruder or fly to a nearby spring for water. While brooding, they followed much the same schedule that the Guatemalan pair had followed while incubating: the male came to the nest between 0845 and 0930 in the morning and took charge of the nestling until his mate returned between 1545 and 1715 in the afternoon. Once, when the male failed to appear, the female sat throughout the day. Until after the twentieth day, the male alone fed the nestling, during the first week giving it three meals daily, between noon and 1500 hours, while in the second week the number of meals was reduced to two, delivered between noon and 1330. Only after she ceased to brood, after the nestling's twentieth day, did its mother feed it. It left the nest when between 27 and 30 days old. At a nest studied by Peeters (1962) in California, parental care followed much the same pattern.

Need of protection.—Of all the Central American pigeons, the Band-tailed seems most in need of legal protection, not only because its large, conspicuous flocks are very vulnerable, but also because it lives in the highlands where the human population is densest. In some areas, as in the Cordillera Central of Costa Rica in the dry season, loose flocks fly down the mountain in the morning, evidently to forage at lower altitudes, then return upward in the

middle of the afternoon. As they fly laboriously up the slopes, often into a headwind, they fall an easy prey to gunners stationed in the open pastures over which they must pass. This slaughter continues into the nesting season.

WHITE-WINGED DOVE

The White-winged Dove (*Zenaida asiatica*) is a brownish pigeon with a conspicuous white area on the wing coverts. It has an extensive but discontinuous range, occurring from southern United States to Costa Rica, in the southern Bahama Islands and Greater Antilles, and on the Pacific coast of South America from southern Ecuador to northern Chile. An inhabitant of arid or open country, in Central America it is found chiefly on the Pacific coast, in the western parts of the highlands, and in dry interior valleys in the Caribbean drainage. Along the middle reaches of the Río Motagua, especially on hot, dry plains which support an open growth of tall cacti and thorny scrub, many White-winged Doves forage over the ground, although they are less abundant than the associated Inca Doves (*Scardafella inca*). They are equally at home in the more arid parts of the Pacific coast, from the Gulf of Nicoya northward. In Guatemala they range far upward into the zone of oaks and pines, and I occasionally met them as high as 9,000 feet above sea level. On the Sierra de Tecpam they nested in March and April, but after the rainy season began in mid-May they vanished and I saw none either on the mountain or on the plateau at its foot, about 7,000 feet above sea level, until late in the following November, a month after the advent of the dry season, when heavy frosts whitened the open fields at the end of every clear and windless night. They sang much after their return at the end of the year. In Costa Rica, where the highlands have a shorter dry season, this dove is rarely seen as high as 4,000 feet.

Unlike the arboreal pigeons we previously considered, White-winged Doves forage over the ground, and in regions naturally forested they are found chiefly in pastures, stubble fields, open woodland, along the roadways, and in similar areas of sparse vegetation. After they have satisfied their hunger they rest in neighboring trees, from which when disturbed they take flight with loudly flapping wings.

Voice.—Of all the pigeons I have heard, White-winged Doves have the longest, most complex, and most distinctive song, which on one occasion sounded to me like *Guu-gu-g'g'gu guu g'gu guuu*. Gosse (1847:306) referred to the "loud stammering coo" of this pigeon, which in the United States is sometimes called the "Singing Dove," and in Guatemala "El Cantorix." Even when heard in a frost-whitened clearing amid the highland oak forests, the White-wing's long-drawn song carried my thoughts back to the hot, cactus-studded regions of the lowlands where I first became familiar with it.

Nest and eggs.—Although in southernmost United States the White-winged

Dove nests, or formerly nested, in great colonies many acres in extent, colonial nesting seems not to occur in Central America. None of the three nests which I found was in sight of another of its kind. The first of these nests was 9 feet up in an organ cactus in a pasture near El Rancho in the Motagua Valley of Guatemala, at an altitude of about 1,000 feet. The second was 8 feet up among the close-set shoots of a pollarded *Viburnum* tree that grew beside a small rivulet flowing between a pasture and a rather open thicket, at an altitude of about 8,500 feet on the Sierra de Tecpam. The third was about 25 feet up, far out on a branch of a cypress tree that stood in an open pasture in the same locality. Each of the nests was a frail, shallow saucer of coarse sticks, about 4.5 inches in diameter. The two highland nests were liberally lined with dry pine needles, but this material was absent from the one in the lowlands, which was without a lining. In each instance the doves had selected a rather solid foundation for their slight structure. The first rested on the flat surface of a fallen cactus branch which had lodged in a horizontal position among the close-set limbs of the cactus tree. The second, in the *Viburnum*, was built upon an old nest, apparently of the Rufous-collared Thrush (*Turdus rufitorques*), by placing coarse sticks around the rim and pine needles in the bowl. The nest itself rested solidly on the cut-off end of the trunk, amid the clustered sprouts. The foundation of the nest in the cypress tree appeared to be an older dove's nest.

Each of these nests contained two eggs when found, that in the Motagua Valley on 25 June 1932, those in the highlands on 23 March and 14 April 1933, at the height of the dry season. These eggs were pure white, and their measurements average 29.7 by 22.1 mm. Those showing the four extremes measured 31.8 by 23.8 and 27.0 by 19.4 mm.

Incubation.—I spent the whole day of 30 March watching the nest in the *Viburnum* tree beside the rivulet, where the doves were incubating two eggs. Passing by starlight over fields where the frozen herbage crunched underfoot, I entered my blind as a many-voiced chorus of Rufous-collared Thrushes swelled through the cold, thin air of the high mountains. The slowly increasing light revealed a dove sitting quietly on the nest. Doubtless this was the female, although in this species the sexes cannot be distinguished by their appearance. When finally the rays of the rising sun struck the hillside behind the nest, an exposure of 5 minutes was enough to melt the white frost from the sparse brown herbage of the pasture, and soon Rufous-collared Thrushes and Steller's Jays (*Cyanocitta stelleri*) were foraging over it with evident success. But the spot where I sat in the shade was long in receiving the warming rays, and it was nearly noon before the numbness left my hands and I ceased to be chilly. In this boreal setting, I watched the nest of a bird which I had come to associate with the hottest and driest regions of the lowlands.

The dove sat nearly motionless, and when her mate arrived at 0832 hours she

still maintained the same attitude in which dawn had revealed her. Appearing suddenly, he alighted in a neighboring rajón bush (*Baccharis vaccinioides*) and approached the eggs by walking over a long, naked, nearly horizontal branch which passed through the *Viburnum* tree close by the nest. As he drew near, the female rose, walked to the other side of the nest tree, took wing, and flew out of sight. Reaching the nest, the supposed male settled slowly on the eggs. Neither partner had uttered a syllable: the changeover was effected in perfect silence save for the whistling of wings in flight and the loud flaps of the male as he arrested his course and of the female as she launched forth into the air.

Then for nearly 5 hours the male sat in the position in which he had settled on his arrival. Although sometimes he preened and shifted the eggs beneath himself, he never rotated in the nest. Toward the middle of the afternoon he grew restless, shifted his position from time to time, stretched his wings, and preened more often than in the forenoon. He also had intervals of drowsiness, when he closed his eyes briefly as though in sleep; but after a second or two, or four at the longest, he would open them to look around. Finally, when the sun was sinking low over the mountains and the thin air was becoming chilly again, his looked-for relief arrived. At 1715 the female alighted in the rajón bush and waited there while her mate, who after sitting without interruption for 8 hours and 43 minutes had become quite restless, slowly stepped from the nest, walked to the outside of the tree, and took wing. Then with mincing steps she walked over the long horizontal branch to the nest, a distance of about 12 feet. As she stepped into it, she uttered a subdued version of her queer, polysyllabic song, then very slowly settled on the eggs. Here she remained motionless while the stars and crescent moon shone forth, and a Whip-poor-will (*Caprimulgus vociferus*) began to call from a perch in the rajón bush close by her.

In the course of the day, these doves had many visitors, and it was interesting to observe their reactions to them. Early in the morning, a Steller's Jay gathered material for a nest from the ground nearby, but the incubating dove seemed indifferent to it. Toward noon a pair of Black-eared Bush-Tits (*Psaltriparus melanotis*) discovered some downy feathers, doubtless shed by the doves, among the branches below the nest and gathered billfuls with much small twittering, at times venturing within a foot of the sitting dove, who paid no attention to these tiny, bustling visitors. When two horses waded up the stream beneath the nest, the dove merely raised his head to discover the source of the sounds he heard. He was equally unperturbed when a bull and three cows came running noisily down the slope toward him, then drank and waded in the stream and cropped the lusher herbage on its banks, sometimes directly beneath him. Yet I could not with the utmost stealth approach within 25 feet of the nest without sending off the sitting bird. Like the Band-tailed Pigeons, these doves were alert

to sounds, looked around for their source, assessed the threat, and stuck to their post as long as this seemed prudent.

On 2 April, the sitting dove, departing from its usual practice, remained on the nest while I approached in full view to within 10 feet. Then, losing courage, it flew directly from the nest with such force that it nearly rolled out an egg. One of the two eggs was pipped. When I returned the following morning, the nest was empty.

INCA DOVE

Nearly everywhere in the drier lowlands of Central America and southern Mexico, the rather harsh, disyllabic call of the little Inca Dove (*Scardafella inca*) is heard on every side through much of the warm, bright day. Although most abundant at low altitudes, the Inca Dove is established in dry interior valleys well into the highlands. The highest point at which I found it in Guatemala was at the foot of the Sierra Cuchumatanes between Huehuetenango and Aguacatán, 7,400 feet above sea level. Although Carriker (1910) does not include this species in his list of Costa Rican birds, it was abundant at Las Cañas in southern Guanacaste in November 1937. Here it associated with Ruddy Ground-Doves, Common Ground-Doves (*Columbigallina passerina*), White-winged Doves, and White-fronted Doves. Since Guanacaste was well known ornithologically in Carriker's time, it is evident that the Inca Dove has extended its range southward, or at least become more abundant at the southern extremity of its range, since the beginning of the present century. Even as late as 1916, Ridgway could cite no record of its occurrence in Costa Rica.

On 16 July 1932, I found an Inca Dove's nest near the railroad above El Rancho in the dry valley of the Río Motagua in Guatemala. The slight structure of straws, fine sticks, and bits of weed stems, 3 inches in diameter, was situated 5.5 feet up in an organ cactus, where it rested in the angle between a short joint and the upright stem. The nest then contained one white egg, and 3 days later there were two, which measured 21.8 by 17.1 and 23.0 by 17.5 mm.

PLAIN-BREASTED GROUND-DOVE

Although the little Plain-breasted Ground-Dove (*Columbigallina minuta*) occurs from southeastern Mexico to Paraguay, its range is discontinuous, and in Central America it is by no means so widely distributed and common as the slightly larger Ruddy Ground-Dove. The single nest that I have seen was found near Los Amates in the Motagua Valley of Guatemala on 24 May 1932. The slight, shallow saucer of grass and straws was situated on the ground in a pasture, at the base of a tuft of coarse grass. Its concavity was 2 inches in diameter by 0.5 inch deep. The two white eggs measured 22.2 by 16.3 and 21.4 by 16.3 mm.

COMMON GROUND-DOVE

The widespread Common Ground-Dove (*Columbigallina passerina*), ranging from southern United States to Ecuador and Brazil, is in Central America found chiefly in the highlands, up to 8,500 feet in Guatemala, and in somewhat arid regions at low altitudes. Here I have discovered no nest, but near Cali in western Colombia I found one on 3 January 1941. The slight, round mat of fine stems was situated on the ground, beneath a small *Lantana* bush that provided scant shade, in a scrubby pasture, near a stream in a deep and narrow valley. It held two white eggs, which were covered by the male parent at 1230 hours. He drew my attention to the nest by fluttering off and walking slowly, mincingly away, keeping himself somewhat shielded behind the neighboring shrubs. Eager to resume incubation, he approached the nest several times while I stood close beside it.

As Griscom (1932:115) pointed out, the Common Ground-Dove and the Plain-breasted Ground-Dove are not found together in Central America. Although their geographic ranges are largely coextensive, they occupy different regions, perhaps as a result of interspecific competition.

BLUE GROUND-DOVE

When I published my life history of the Blue Ground-Dove (*Claravis pretiosa*), I was able to report only one determination of the incubation period, and a doubtfully adequate one of the nestling period (Skutch, 1959). At a nest found in a coffee bush in 1960, the first egg was laid during the daytime of 22 February and the second between 0715 and 1225 on 24 February. The first had hatched by 0725 on 9 March, and the second between 1700 on this date and 0730 on 10 March. The incubation period was accordingly between 14 and 15 days, slightly longer than my earlier determination of approximately 14 days. One of the nestlings in the coffee bush died. In the afternoon of 21 March, I found the survivor resting a few inches from the nest. The following afternoon it was resting on the nest's rim, and by the afternoon of 23 March it had gone, leaving the nest heavily soiled. Its nestling period was 13 or 14 days. The nestlings which disappeared when only 9 days old, as earlier reported, were probably driven from their nest prematurely, if not carried off by a predator.

Five nests found in El General since my earlier paper was published bring the total up to 23. Eggs were laid in these nests as follows: February, 5; March, 8; April, 10; July, 1; August, 3; September, 1. It is instructive to compare this distribution with those given beyond for the White-fronted Dove and the Rufous-naped Gray-chested Dove. In all three species, freshly laid eggs are rare or absent in May and June, the first 2 months of heavy rains, and laying is resumed, but on a reduced scale, in July, August, and September.

WHITE-FRONTED DOVE

The brightest color of the plainly attired, brownish and grayish White-fronted Dove (*Leptotila verreauxi*) is the beautiful cinnamon-rufous which it reveals when it raises its wings; but this coloration of the under wing coverts does not suffice for identification, because it is shared by other members of the genus. The White-fronted Dove has a wide range, extending from southern Texas to central Argentina and from the Atlantic Ocean to the Pacific. In Central America it is present over the whole Pacific slope, from sea level up to about 8,500 feet in Guatemala and 5,000 feet in Costa Rica, but on the Caribbean slope its occurrence is restricted. Where the continental divide is not too high, as on the Isthmus of Panama and in central Costa Rica, it "spills over" from the Pacific side, and it is also found in somewhat arid valleys in the Caribbean drainage of northern Central America. It prefers conditions intermediate between those of the humid rain forest of the Caribbean littoral and those of the driest parts of the interior valleys. Where Inca Doves and White-winged Doves abound amid cacti and thorny scrub, as in the most arid section of the Motagua Valley, White-fronted Doves are not often seen, although these three species occur together where the vegetation is somewhat more luxuriant. In the valley of El General, White-fronted Doves have become numerous in clearings in the heavy forest. Because of its great geographical range and tolerance of varied ecological conditions, this is the pigeon which the bird watcher who travels widely through the tropical and subtropical parts of the American continents is likely to meet in more localities than any other.

In the regions where I am familiar with it, the White-fronted Dove avoids both the interior of heavy forest and broad, treeless fields. It prefers light and somewhat open thickets, orchards, plantations of coffee or bananas, and shady pastures and dooryards. In October and November I have usually found single individuals in El General, but by December many White-fronted Doves are in pairs. In my experience, this dove never flocks. It forages chiefly, if not exclusively, on the ground. It is fond of maize and enters thatched granaries with open fronts to pick up exposed grains. While feeding chickens on the lawn in the early morning, I have often watched one or two of these doves hovering on the outskirts of the flock, gathering the grains of maize which I threw farthest. Later, when the domestic fowls have gone off to scratch at the woodland's edge, the doves come to eat what they have left, not disdaining spoiled grains which the chickens reject. Sometimes the doves looking for corn chase each other, and one immature White-fronted Dove chased a Rufous-naped Gray-chested Dove. But I have seen no fighting.

Voice.—In December, when after long months of heavy rainfall the weather becomes drier in El General, the White-fronted Doves begin their sonorous calling. They are most vocal in the warmer parts of the day, toward noon and

in the early afternoon. Perching inconspicuously amid dense foliage, often inside the compact crown of an orange tree, they repeat their hollow notes over and over interminably. The full, deep, long-drawn, moaning *coo-ooo* has a peculiar tone quality which makes it unmistakable. While producing this distinctive call, the dove puffs out its chest most conspicuously but keeps its bill closed, apparently emitting the sound through its nostrils. These doves have another utterance which I have far more rarely heard. More musical, higher in pitch, and almost soprano in tone, it consists of two parts and sounds something like *coo woo*. The same individual sometimes produces both of these calls alternately. Amid the coffee groves and low copses of the Central Plateau of Costa Rica, I heard the deep hollow call much in October, when these doves are rather silent in the wetter region of El General. Over much of the Pacific slope of Central America, this is one of the most characteristic bird notes through a large part of the year.

Nest building.—In the valley of El General, the White-fronted Dove sometimes begins to breed in late December, but few of its nests have been found before March. Most of the 20 nests that I have encountered in El General were placed in bushes and tangles of vines in low and often dense thickets, from 1 to 2 yards above the ground. Very rarely they were lower than this; the lowest of all was only 1 foot up on matted calingüero grass (*Melinis minutiflora*) on a steep slope above the edge of a thicket. Sometimes the nest was placed on a stump. One pair had built on a stump a yard high and about 1 foot in diameter, at the edge of a patch of cassava (*Manihot utilissima*). Another nest was 5.5 feet up on the top of a sprouting stump in a field of sugarcane. One nest was 9 feet up on a horizontal branch of a poró tree (*Erythrina Berteroana*) growing in a small coffee plantation. White-fronted Doves may be tempted by some especially attractive foundation to build even higher than this. A nest was placed 13 feet up on the base of a large plant of the golden-spray orchid (*Oncidium* sp.) in a calabash tree with dense foliage. In two successive years, the same female built 15 feet up in a burío tree (*Heliocarpus appendiculatus*) standing close by our house. Here the attraction was a platform-like expanse between four thick upright branches, shaded by a small epiphytic bush, the whole forming a well-enclosed, secure foundation. But nests as high as this are exceptional. The extreme range in height of 19 nests was from 1 to 15 feet. Twelve of these nests were from 3 to 6 feet up, two were below 3 feet, and five were above 6 feet.

Among the doves which early in 1952 hunted over our lawn and picked up grains of maize was a White-fronted Dove with a swelling on the back of its neck, which made the feathers stand out unevenly in a sort of ruff. We saw much of this dove, and after a while we began to refer to it as "Ruffles." At first we did not know the sex of this bird, but later, when it nested close by

the house, it became evident from its behavior that it was a female. In July 1952, Ruffles was very lame and hopped over the ground with one foot held up. By October she had nearly recovered and walked with only a slight limp, which she afterward lost. Fortunately for my studies, she did not lose her ruff, which for well over 3 years served as a conspicuous mark of recognition in a species of which the sexes are normally indistinguishable in appearance. Once I met Ruffles in a second-growth thicket beside the river, about 1,000 feet from the dooryard where she was often to be found.

In 1953, and again in 1954, Ruffles and her mate, who bore no recognition mark and so was not necessarily the same in both years, nested in our garden. In both years the history of their nesting was much the same. The first nest was built in a very dense clump of *Thunbergia erecta* on the bank in front of the house, two eggs were laid, and they vanished before hatching. Then, after an interval, the pair built a second nest in the platform-like crotch of the burío tree, 110 feet distant from the *Thunbergia*—the highest nests that I have seen, whose site has already been described. In the first year the nest was well shaded by the crown of the tree, but by the second year the crown had been cut away, because the tall, easily uprooted tree menaced the house, and the nest was exposed to the sky, although well enclosed on the sides. In both years, the second nest was successful, but in neither was it followed by another in the garden.

In 1953, the first nest, in the *Thunbergia*, had its full set of eggs on 11 March and was empty by 17 March. At 0820 on 20 March, I found Ruffles sitting in the crotch of the burío tree, while her mate picked material from the lawn and carried it up to her. Each time he took a single article in his bill, but often this was a fairly large, branched piece of dry grass or weed. Sometimes he picked a piece from the ground, shook it, then promptly dropped it as unsatisfactory. Flying up to the crotch with his burden, he usually entered from the north, passed by or over his mate to deposit the material beside her, and promptly emerged on the south, to fly down to the grass for more. Often I clearly saw that he stood on the female's back while he laid his billful beside her, but sometimes he seemed merely to pass by her. He never arranged what he brought, leaving this to his partner, who often turned around in the nest and, as far as I could see, gave much attention to shaping it. Frequently she rapidly vibrated the tips of her wings as the male approached her. From 0820 to 0920 the male dove brought material 12 times. From 0920 to 0953 he made 14 trips. Then Ruffles flew down to the ground, where she and her mate touched bills and each nibbled the feathers of the other's neck. She had not returned to the crotch by 1020.

The following day, 21 March, I found Ruffles sitting on the nest soon after sunrise, but she did not stay long. After she went I examined the nest and

found it far from finished. At 0851 hours Ruffles went to sit on it. Next her mate came, looked down at her from a neighboring branch, then flew to the ground. He brought nothing on this visit of inspection. While he was absent, Ruffles called from the nest in a low voice. From 0851 to 0948 he made ten trips with materials, which he laid beside his partner as on the preceding day. The pieces were on the average smaller and finer than those he had brought the day before. Often they were curling petioles, and always they were carried singly. When he delayed long to bring something, Ruffles called softly from the nest. At 0948 she flew down, and no more building was done that day, as far as I saw. On the following day the pair worked between 0800 and 1000 hours. The nest was completed in 3 or 4 days.

A typical nest of the White-fronted Dove was a thick, shallowly concave platform that measured 5 to 6 inches in diameter, not including the projecting ends of sticks. The pile was about 3.5 inches thick. It was composed of weed stems, straws, sticks, dry pieces of vine, fragments of fronds of the bracken fern, rootlets, and the like. The longest stiff pieces were two crooked straws about 12 inches long: but three very thin, curved pieces of vine were, when straightened, 20, 18, and 16 inches long. Most of the nest's components were under 10 inches long. The nest contained over 350 pieces of material, not counting the finest fragments. It weighed 68 grams. White-fronted Doves' nests are among the thicker and more substantial of pigeons' nests.

The eggs.—Of 20 nests of the White-fronted Dove in El General, 18 contained two eggs or nestlings, the remaining two a single egg or nestling. This dove likewise lays sets of two eggs at the northern extremity of its range in Texas. Because the doves spend so much time on the nest before their set is complete, and frequent interruptions may cause desertion, it is difficult to learn when their eggs are laid. When Ruffles settled on her second nest in the burío tree in the evening of 31 March 1954, there was still no egg. She sat through the night and by 0700 next morning she had laid the first egg, which was covered intermittently during the day of 1 April. At 0710 hours on 2 April, there was still the single egg. From 0800 to 1500 I looked frequently at the nest, but each time one member of the pair was sitting and I could not see what it contained. Finally, at 1500, I chased off the dove and found two eggs, the second of which had been laid since 0710 that morning. At nest 12, the first egg was present at 0725 on 4 July and the second was laid between 0805 and 1030 the next day. At nest 17, the second egg was deposited between 0700 and 1015. The second egg of a set is laid somewhat more than 24 hours after the first, but the exact interval is unknown.

The eggs are white or sometimes pale buff, without much gloss. The measurements of 15 average 29.6 by 21.6 mm. Those showing the four

extremes measured 31.0 by 21.0, 29.4 by 23.0, 27.8 by 21.8, and 29.4 by 20.2 mm. This does not include a runt egg which was only 22.2 by 16.7 mm.

In 20 nests in the valley of El General, 2,000 to 3,000 feet above sea level, eggs were laid as follows: December, 1; January, 1; February, 3; March, 7; April, 3; July, 3; August, 1; September, 1. As in the case of the Blue Ground-Dove, the absence of records in May and June seems significant, for these are the very months when I have devoted most time to the birds, most kinds of which are then at the height of their breeding season.

Incubation.—The nest in the burío tree was too well screened to invite prolonged observation, and I made no study of the pattern of incubation in this species. I saw Ruffles, the female, replace her mate at various times between 1500 and 1630 in the afternoon, and she sat through the night. In 1953 she laid her second egg between 0700 and 1015 hours on 25 March, and it hatched between noon on 8 April and 0615 on 9 April, so that the incubation period was not less than 14 days and 2 hours nor more than 14 days and 23 hours. The following year, Ruffles laid her second egg between 0710 and 1500 on 2 April, and it hatched between 0700 and 1640 on 16 April, giving an incubation period between 13 days and 16 hours and 14 days and 9.5 hours. The incubation period is, then, approximately 14 days.

Parental care.—White-fronted Doves are among the most devoted parents that I know. When covering eggs or young, they sometimes permit a man to approach within arm's length before they take flight. They spend much time guarding their nestlings, even those which are well feathered and ready to leave the nest. When driven from their young, they give some of the most prolonged, vigorous, and convincing distraction displays that I have ever witnessed. And, unlike many other pigeons, they keep their nest irreproachably clean as long as it is in use.

On 26 July 1936, a boy led me to see a White-fronted Dove's nest which he had found in a small coffee plantation. Sitting above our heads in a poró tree, the dove apparently felt secure, for our presence beneath it, and shaking the supporting limb, did not even make it shift its position. Next morning I returned with a mirror and a long stick to see what the nest contained. When I touched the sitting bird's tail with the stick, it raised its wings straight up above its back, in an attitude of defiance that revealed the beautiful cinnamon of the inner surfaces, which are ordinarily concealed. Hoping to make the dove depart, I tried to touch it again with the stick's end, which received a resounding blow from the uplifted right wing.

I then abandoned the attempt to make the dove leave its nest; but thinking that I might glimpse the contents when it rose up in an attitude of defiance, I tied the mirror to the stick and raised it toward the bird. When the intruding object reached the level of the nest, the dove suddenly dropped to the ground and

began to move away, hopping and limping, quivering its wings or loosely flapping them, as though badly injured and unable to fly. The weeds beneath the coffee bushes had just been cut, leaving the ground clean and free of obstructions, an excellent stage for the dove's performance. I followed it at a walking pace: and the bird, all the while moving as though in the greatest agony and distress, easily kept its distance of 15 or 20 feet ahead of me, until it reached the edge of the plantation, 200 feet, as measured later, from its nest. Here the dense growth of weeds and bushes forced it to interrupt its display, and it flew over the barrier into the neighboring thicket. But it alighted on a log in full view of me and stood fluttering its wings as though trying vainly to fly. Tangled vines prevented my following, and after a minute of this acting the actor vanished amid the dense vegetation. When I returned to the nest, my uplifted mirror revealed a single half-grown nestling. Never before had I seen a pigeon defend its nest so bravely, nor make such an earnest attempt to lure me away when finally it was forced to retreat. At every stage of its complex performance, it gave the impression that it was acting with intelligent deliberation, carefully calculating the risks it ran, adapting its performance to the diversities of the surroundings, taking care not to jeopardize its own life while it safeguarded that of its offspring.

One day when I visited another nest that contained a single nestling whose feathers were just beginning to expand, the brooding parent stayed until I almost touched it, then dropped to the ground and fluttered off in a distraction display such as I have already described. A few seconds later, the nestling, quite unable to fly, jumped from the nest and tried to escape over the ground. Easily overtaking it, I replaced the young fugitive in the nest and held it there until it had become calm and made no further attempt to flee.

After this episode, I did not again go near this nest but viewed it from a distance. On every visit, even in the warm middle of the day, I found a parent brooding the now fully feathered nestling. On seeing me, the parent crouched low in the nest, usually with the youngster's head and neck projecting from beneath the parental breast. One afternoon I approached a little nearer than usual, examining the parent and all that was visible of the nestling through my field glasses. The parent at first crouched low, as was its habit, but under my continued scrutiny it became alarmed, fluttered to the ground, and dragged itself away with a flapping of wings all out of proportion to its slow progress. As soon as the parent had passed beyond view, the nestling rose from the nest and went off in the opposite direction. It now flew well, and it did not stop until it was completely hidden from me by the surrounding bushes.

Parent White-fronted Doves appear regularly to use this ruse to divert an intruder's attention while their fledglings escape in another direction. At 0730 hours on 25 April 1953, I went to look at Ruffles' nest in the burío tree, where

an hour earlier a parent had been guarding at least one of the feathered young. With my eyes raised toward the nest, I was startled by a flapping of wings from beneath a neighboring orange tree. A parent dove circled close around me, came down on the grass about 10 yards away, spread its wings broadly and waved them slowly up and down while standing in one spot or walking deliberately over the ground, as though unable to fly. At the moment when the parent began this elaborate distraction display, one or both of the young flew directly off to the far end of the garden. My first impression was that three doves rose from beneath the orange tree in a single burst of wingbeats; but later, when the parent had ceased to display, I could find only a single fledgling, who flew off in a competent fashion, then walked farther away over the surrounding pasture, quite steady on its legs. Climbing then to the nest, I found that both fledglings had gone.

Newly hatched nestlings bristle with the hair-like feathertips typical of young pigeons. Their feathers expand when they are 9 or 10 days old, producing a plumage which resembles that of the adults, except that it is duller and many of the feathers of the back and breast have pale margins, producing the effect of scales. The juvenile's outer rectrices have white tips, as in the adults. But the young dove's eyes are brown, giving it a dreamy, contemplative expression, whereas the bright yellow eyes of the parents impart an alert, startled aspect. The bare skin that surrounds the fledgling's eyes is very dull bluish, not bright blue as in the adults. At one nest, the nestling period was 15 days; at two others, it was 16 days.

Although I have always found White-fronted Doves' nests quite clean after the fledglings departed, the broad platform around the nest in the crotch of the burio tree held an accumulation of droppings. Thus these doves, which surpass many other members of their family in their attention to sanitation, fall short of the majority of passerine birds, although they do better than a few, notably the goldfinches (*Spinus* spp.) and their relatives.

GRAY-CHESTED DOVE

The Gray-chested Dove (*Leptotila cassinii*) is confusingly similar in appearance to the slightly larger White-fronted Dove. In flight the two can sometimes be distinguished by the fact that the White-fronted Dove has all but the innermost tail feathers more or less broadly tipped with white, whereas in the Gray-chested Dove only one to three rectrices on each side are so marked. If one can approach near enough, he can readily distinguish these doves by the colors of the featherless parts of the face. In the Gray-chested Dove, the bare skin around the eyes and on the lores is red, while in the White-fronted Dove it is bright blue. In both species, the iris is yellowish to orange, the bill black, the legs and toes some shade of red.

The Gray-chested Dove inhabits the humid Caribbean lowlands over the whole length of Central America and extends into adjacent portions of southern Mexico and northern Colombia. According to Carriker (1910:403), its vertical range in Costa Rica is from sea level to about 3,000 feet, with some stragglers going higher, and it is most abundant between 500 and 1,500 feet. A forest dweller, it forages over the leaf-strewn ground singly or in pairs, never in flocks. Its note is a long-drawn, rather mournful *cooo*, interminably repeated during the dry season.

Nesting.—In 1935, I found four nests of this dove in the lighter parts of the forest on Barro Colorado Island in the Panama Canal Zone. Two were placed in dense tangles of vines, and two on fallen palm fronds which had lodged in the undergrowth and formed broad platforms for the nests' support. In height the four nests ranged from 3 to 9 feet above the ground. They were slight, frail platforms or mats with little or no rim, composed of a few dry twigs, tendrils, and similar materials. One platform was 5 inches in diameter. When found on 19 February, the earliest of these nests held two nestlings in long pinfeathers. Each of the other three nests contained two white eggs, which in the case of the latest were laid about 5 April. The eggs in two sets measured 29.4 by 21.3, 29.4 by 22.2, 23.6 by 21.4, and 29.0 by 21.4 mm. Others have found this dove nesting in the Canal Zone from April to September (Eisenmann, 1952:21).

My attention was drawn to the earliest of these nests when a pigeon burst out of a thick tangle of vines beside the trail along which I was passing through the forest. Since I saw little of the rapidly departing bird, I set up a blind before the nest with two nestlings, in order to enjoy a close view of the parents and identify them. While sitting in the blind, I began to wonder how often the nestlings would be fed, and to satisfy my curiosity I spent the whole of the morning, all of the following afternoon, and most of another morning watching them.

Through the early morning of 20 February, the parent continued to sit motionless on the nestlings just as the light of dawn revealed her, with neck drawn in and bill pointing slightly downward. At 0822 hours she suddenly arose and flew away. At 0855 a dove, doubtless the male, alighted on a branch 2 feet from the nest and walked to it. His first act was to pick up and swallow all the droppings that had accumulated there. The nestlings in pinfeathers stretched up in front of him, gently touching the feathers of his neck with their bills, silently begging for food, but he did not at once respond. After considerable delay, he moved to the center of the nest and covered the nestlings. About 10 minutes after his arrival, he yielded to their entreaties, took a nestling's bill in his mouth, and regurgitated to it. For a while the second nestling rested quietly beneath his breast, but in the midst of the feeding it rose up and continued

to touch the parent's bill, until he shook out the bill of the first nestling and received that of the second into his own. Presently the first managed to push in its bill from the other side, and the two received nourishment simultaneously. While the parent held the bills of one or both nestlings in his mouth, he apparently did not regurgitate to them continuously, for he made violent jerking movements with his head only by spells, which were separated by considerable intervals when he rested quietly holding their bills in his mouth. The feedings occupied about 25 minutes, and at their conclusion the parent brooded the nestlings, or preened their sprouting feathers as they lay in front of him. Although I continued to watch until 1130 hours, no more food was given to the young.

At 1140 on the following day, I resumed my watch. The parent, doubtless again the male, was sitting just as I had left him 24 hours earlier. As the hours slipped by he rarely moved and never changed his position, while the nestlings rested inertly beneath him. At intervals during the afternoon light showers fell. Finally, at 1630, his mate arrived, alighted on the ground between me and the nest, and stood there for many minutes, uttering a very low *coo* scarcely audible 15 feet away, the while bobbing her head up and down and jerking her tail. Then she flew up into the tangle and walked over the thickly matted vines to the nest's side. Here she stood while her partner arose, walked slowly to the edge of the tangle, and flew off into the forest. Then she stepped into the nest and, after a long delay, took the nestlings' bills into her mouth, one on each side, and regurgitated to them for 17 minutes, finally ending the meal by opening her bill and shaking out the bills of the young, who continued to stretch up their heads for more.

Presently the parent ate all the nestlings' excrements that lay before her on the nest, performing this office *after* feeding the young rather than *before* feeding them, as her mate had done. But 40 minutes later a begging nestling persuaded her to feed it for 2 minutes more, after which further requests for food failed to elicit a response. As happened years later in the case of the Ruddy Quail-Dove, which similarly cleans its nest, I wondered whether the parent Gray-chested Doves fed back to the nestlings the excrements they picked up so soon before they began to regurgitate, and if not, how they avoided doing so. When it had become too dark to distinguish the dove, I left her brooding her nestlings.

Two mornings later, I began to watch this nest at 0645 hours, when a parent, doubtless the female, was brooding. At 0830 the nestlings, who hitherto had rested quietly beneath her, crawled out in front and after a while started to preen their expanding feathers. Then, as the hour for their breakfast approached, they stretched up and ruffled the feathers of their mother's neck, sometimes touching her bill with theirs, begging for food. Apparently having nothing to

give them, she continued to sit motionless just as I had found her 2 hours earlier, until at 0848 her mate flew up, walked over the matted vines, and stood beside her at the nest's edge. Only then did she arise and leave. Four minutes later, the newly arrived parent began to feed first one nestling, then both together, and continued to do so for 15 minutes. Despite the youngsters' entreaties, no more food had been given by 1020, when two people passing along the trail frightened the parent away. It had not returned by 1130, when I left.

Thus these nestlings, whose feathers on 23 February were beginning to unsheathe, were brooded, or at least guarded, almost continuously. During 13 hours of watching on 20 and 21 February, they were alone for only 33 minutes, and on 23 February they were attended constantly until the parent was frightened away. The parents alternated on the nest according to the schedule which they had probably followed while they incubated. Each gave the nestlings one long meal, beginning shortly after its arrival and lasting for 15 to 25 minutes; and once the female delivered a second, much shorter meal.

Twice, during my afternoon watch, a party of Rainbow-billed Toucans (*Ramphastos sulfuratus*) flew heavily and noisily about in the trees above and around the doves' nest. Each time that this happened, the male dove depressed his neck, bent down his head, and slightly spread his wings. This apparently made him less conspicuous from above, for his nearly white forehead, face, and throat, as likewise his light-colored breast, were turned downward, while his brown dorsal plumage was presented to the nest-robbing birds in the trees above him. His spread wings screened the light plumage of his sides. The crouching dove blended well with the brown sticks of the nest and the dead stems of the vine tangle that supported it. On both occasions, the dove slowly raised his head and folded his wings, resuming his normal posture, as soon as the toucans had passed from view.

Later in the evening, after the female had returned to the nest, a party of White-faced Monkeys (*Cebus capuchinus*), including a mother with a half-grown child riding on her back, passed with stupendous leaps through the treetops above us. Noticing my blind, some of the party raised an outcry; nevertheless, the brooding dove did not crouch as her mate had done while the toucans were above him, but sat in her usual attitude. Yet these monkeys are, as I have seen, nest robbers, just as the toucans are. Likewise, the passage of a Three-toed Anteater (*Tamanduas tetradactyla*) through the undergrowth not far from the nest, and that of a band of Collared Peccaries (*Pecari angulatus*) which I did not see but strongly smelt, seemed not in the least to perturb the parent dove.

The nestlings were heavily infested with *tórsalos*, dipterous larvae which live beneath the skin of the warm-blooded animals they parasitize. One nestling had nine big lumps, caused by these pests, on its head and various parts of its

body. Yet they evidently had not seriously retarded its development, for this nestling was larger, with plumage further advanced, than its sibling, who supported fewer parasites. Neither their parents nor the Gray-chested Doves attending eggs ever gave a distraction display.

RUFIOUS-NAPED GRAY-CHESTED DOVE

The Rufous-naped Gray-chested Dove (*Leptotila cassinii rufinucha*) is readily distinguished from the preceding forms of *Leptotila* by the warm tawny-brown of its hindhead and nape. Its eyes are pale yellow: the bare skin around them and on the lores is red; the bill is black: the legs and toes are red. Formerly, and perhaps rightly, considered a distinct species, the Rufous-nape is now usually classified as a race of the Gray-chested Dove, from which it differs in appearance far more than the Gray-chested Dove differs from the White-fronted Dove. The Rufous-nape inhabits a limited area on the Pacific side of the continent, extending from the Gulf of Nicoya in Costa Rica southward and eastward as far as Veraguas in Panama. In El General, where it is abundant, it nests as high as 3,000 feet above sea level.

This dove forages largely on the ground beneath the heavy rain forest, and often while sitting in a blind in the woodland, studying the nest of some other bird, I have watched one of these doves, or a pair of them, walk by with bobbing heads, pausing here and there to pick up some small particle of food. Here in the forest it is the only representative of its genus; but when it forages in riverside groves, second-growth thickets, or even in neighboring shady pastures and dooryards, it mingles with its paler-colored relative, the White-fronted Dove. One day, while I watched a nest of the Blue-diademed Motmot (*Momotus momota*) in a roadside bank, two Rufous-napes, evidently a pair, and a single immature White-fronted Dove foraged for a long while on the leaf-stewn roadway in front of my blind. The Rufous-napes, who stayed close together, pushed aside the fallen leaves and other litter with short, sideward jabs of their black bills. Among other things, they ate the small, black berries that had fallen from the various woody melastomes that overhung the road. When the Rufous-napes approached each other, one sometimes rapidly twitched the ends of both its folded wings, in a movement of slight amplitude. They foraged in silence. I noticed no antagonism between these doves and the immature White-fronted Dove, who often came close to them.

Rufous-napes used to enter the thatched shed with an open front, where for many years we stored our maize. They pick up corn which I throw far out for them while feeding the chickens, and after the departure of the latter they hunt over the lawn for grains which the domestic fowls have overlooked or disdained. Here the Rufous-napes often meet the White-fronted Doves, which have similar habits, and are often chased by the latter. But the White-fronts show no

more antagonism toward these smaller relatives than toward others of their own species, and I have never seen any conflict more serious than a mild pursuit.

Voice.—A frequent call of the Rufous-nape is a long-drawn *cooo-ooo*, similar to that of the White-fronted Dove, but weaker and less resonant, so that it sounds more sorrowful to one who listens to it imaginatively. One dove whom I watched foraging over the bare ground of a gully uttered a long-continued, mournful *woooo* which seemed to cost it much effort, for to produce this note it paused in its march and puffed itself up, particularly its breast. This same individual also voiced a short *coot*, much like the call of the Blue Ground-Dove. For this more effortless performance, the dove did not need to interrupt its walk.

Nesting.—In El General, breeding begins early, and one female laid her first egg on 19 February 1960. Although the Rufous-nape sometimes forages well within the forest, I have seen no nest so situated. Of my eight nests, two were at the woodland's edge, four in tall, dense second-growth thickets, and one in an open part of a low, impenetrable thicket. These nests were supported on slender branches, usually amid a dense tangle of vines, at heights ranging from 3 to 15 feet above the ground. The average height of the eight nests was 9 feet. A typical nest was a shallowly concave platform composed of fine sticks, straws, weed stems, tendrils, petioles, and the like. It measured 5 inches in diameter, excluding the projecting ends of the twigs. The longest stick in the nest was 14.5 inches long, and two were about 12 inches long, but most of the pieces were considerably shorter, ranging down to fragments less than an inch in length, which may have been broken from larger pieces. The nest contained 143 pieces of all sizes and weighed 30 grams. Twenty-five feet away, on the other side of a narrow pathway that traversed the thicket, was the above-described nest of the White-fronted Dove, that contained over 350 pieces and weighed 68 grams. The nests of *Leptotila cassinii* are usually much slighter than those of *L. verreauxi*; often the eggs can be seen through the bottom of the former, although this is usually impossible in the case of the latter. In the closely neighboring nests of the two congeneric species, incubation was in progress at the same time, indicating that there is little antagonism between these related birds.

The Rufous-nape's slight nest is constructed very rapidly. On 2 April 1939, I found a pair of doves just beginning to build on a horizontal, vine-draped branch at the forest's edge. The following morning I hid amid the surrounding foliage to watch them at work, but they saw me and refused to continue. When I arrived with my blind at daybreak on 4 April, I found a dove, probably the female, sitting on the nest site, where she remained while I set up the brown tent and took my place within it. In the dim light of dawn the male began his melancholy cooing in the neighboring forest and continued until about sunrise, while his mate replied with more subdued notes from the nest. At 0622 hours

he alighted on a branch a few feet from the nest bearing a fine twig, which he carelessly dropped, and then descended to the ground for another. At this point the female rose up for the first time since I began my watch, and I was surprised to glimpse an egg, for in the middle of the preceding morning the nest had been too rudimentary to support such an object. Ten minutes later, the male returned with a stick in his bill, and as he walked toward the nest his mate arose and flew away. He stepped into the nest, deposited his twig, and departed. After a further absence of 9 minutes, he brought a single dry petiole, placed it on the nest, then settled on the egg. While sitting he repeated the long, deep *cooo-ooo* from which I inferred his sex, and the answering calls of his partner floated out of the distance. Soon becoming silent, he sat continuously for the next 2 hours. I then left, but on a number of subsequent visits through the morning I always found the egg covered. On the following day at 1000 hours, two eggs were present.

On 19 February 1960 at 1010 hours, I found a nest with a single egg, which was covered by one of the parents at 1100 and again at 1630 on the same day. The second egg was laid between 0825 and 1235 on the following day. These eggs, whose slightly glossy shells were faintly buff, measured 27.3 by 20.9 and 26.0 by 21.5 mm.

In El General, 2,000 to 3,000 feet above sea level, eight sets of eggs were laid as follows: February, 2; March, 2; April, 1; July, 1; August, 1; September, 1. In the last of these nests, the eggs were still unhatched by the first day of October, which is often the rainiest month of the year. Although the number of records of nests of this species is small, their distribution by months is strikingly similar to that of the nests of the White-fronted Dove and the Blue Ground-Dove in the same locality.

At the nest where the second egg was laid on the morning of 20 February, the first egg was well pipped at 1600 hours on 4 March. When, an hour later, I returned expecting to see a newly hatched nestling, an empty nest greeted me. In the same interval, the eggs vanished from the nest of the White-fronted Dove 25 feet away. Probably both nests were pillaged by a snake. This frustrated attempt to learn the length of the Rufous-nape's incubation period suggested that it was about 14 days, as in the related White-fronted Dove.

Whether they cover eggs or young, Rufous-napes are admirably steadfast. At the beginning of incubation, birds are as a rule more easily sent from their nests than they are later as their eggs near the point of hatching; yet the dove whom I watched build continued to sit on the newly laid egg while I gently shook the supporting bush; and in order to see what he covered, I found it necessary to coax him to go by tapping on the branch. The following morning, when he was incubating two eggs, he returned to them 5 minutes after I ended my visit of inspection. One day while I was collecting plants, another Rufous-nape called my attention to its nest and eggs by suddenly flying away while I was in the midst

of plucking specimens from the shrub that helped to support the frail structure. A parent whom I disturbed while it brooded an unfeathered nestling amid a thicket fluttered down to a low branch, about a yard from the ground and on the side of me away from the nest. Here it slowly and deliberately beat its wings, with a rhythm too regular to suggest that it was injured but which served very well to attract the intruder's attention. When I approached closer, it flew off, skimming low above the ground until it vanished among the bushes.

RUDDY QUAIL-DOVE

Since the publication of my paper on the Ruddy Quail-Dove (*Geotrygon montana*) in 1949, I have discovered 14 additional nests, all on our farm, bringing the total number that have been found in El General up to 21. These new nests were, like those previously described, all in the primary forest or adjacent stands of tall second-growth woods with a closed canopy. They tended to be lower than the earlier nests, although one was higher. The range in height of all the nests was from 18 inches to 9 feet. Four nests were below 2 feet and five above 4 feet; all the remainder were between 2 and 4 feet. The highest nest was built upon an aroid that grew attached to the side of an erect trunk. The lowest nest was on a maze of slender branches of low bushes; it was composed of large dead leaves that formed a broad and shallow platform, with one small green leaf and one dying leaf in its center. Another nest was in the midst of a cluster of fronds of a thick-leaved polypody fern (*Polypodium crassifolium*) growing on a rock. Situated about 3 feet above the ground, it was a concave platform, loosely constructed of large dead leaves, petioles, and sticks, all of which might have fallen into the fern plant from the trees above it. All the 21 nests held two eggs or nestlings. The eggs, unlike those of most pigeons, are pale or even deep buff in color.

In 21 nests in the valley of El General, 2,000 to 2,500 feet above sea level, eggs were laid as follows: March, 2; April, 4; May, 8; June, 3; July, 3; August, 1. My earliest date for eggs is 11 March, when a completed set was found. It is of interest that most eggs were found in May, which is the month when no eggs of *Claravis* and the two species of *Leptotila* were noticed in the same neighborhood. The difference in time of nesting is probably correlated with differences in diet. The quail-dove hunts over the ground, always within the woodland, and probably depends largely on small invertebrates for its food; the other three species forage on the ground, to a large extent outside the heavier woodland, and evidently eat many seeds, which in weedy areas are most abundant late in the dry season.

The quail-dove's incubation period of 11 days and a few hours is unusually short for a pigeon. From three nests the young left when only 10 days old, at which age they could both fly and walk in a competent manner.

BUFF-FRONTED QUAIL-DOVE

The Buff-fronted Quail-Dove (*Geotrygon costaricensis*) is a beautiful bird, clad in rich maroon and bluish or greenish gray, with a buffy forehead and white cheeks bordered below with a black line. This dove is found in the mountains of Costa Rica and western Panama, from 3,000 or 4,000 to 10,000 feet above sea level (Ridgway, 1916:489). Near Los Cartagos in the province of Heredia, Costa Rica, I occasionally glimpsed it, walking over the ground in shady places or flying rapidly by, but it was rare, shy, and difficult to observe. Here, on 22 June 1963, I found a nest amid the bamboo undergrowth of heavy oak forest, near its edge, at an altitude of 7,500 feet. The nest was 13 feet up on a slender, mossy, horizontal branch of a tall shrub, where it was supported by lateral twigs and a small bromeliad. The nearly flat platform, measuring 10 by 7 inches in diameter, was composed of coarse twigs, a few rootlets, and much green moss and liverworts. In no other pigeon's nest have I seen moss or liverworts; yet it was not surprising to find that the dove had incorporated them in its structure here in the cloud forest, where these bryophytes grew profusely on the trees and shrubs and many birds used them in their nests. When I first saw this dove's nest, it contained a single nestling in pinfeathers, which reared up threateningly with upstretched neck when I raised a mirror to see what the nest held. Ten days later, many feathers scattered over the mossy platform were evidence that the young dove had been attacked by some predator. The nest was heavily soiled with droppings, from which I concluded that Buff-fronted Quail-Doves are less careful of sanitation than their lowland relatives, the Ruddy Quail-Doves.

MOURNING DOVE

According to Eisenmann (1955:36) the Mourning Dove (*Zenaidura macroura*) breeds locally in Central America in British Honduras, Honduras, and western Panama. Long ago, Osbert Salvin believed that this dove was resident in Guatemala (Griscom, 1932:112), and George Cherrie thought that it was probably resident at San José, Costa Rica. Commenting on this view, Carriker (1910:397) expressed the opinion that the few individuals of this species found in Costa Rica in the summer months had failed to migrate northward in consequence of injury, sickness, or some sexual derangement, as not infrequently occurs in shorebirds.

As far as I know, no proof of the Mourning Dove's breeding in Costa Rica has ever been published. In mid-August of 1938, I found these doves not uncommon on the Las Cónovas coffee estate, near Cartago at an altitude of 4,500 feet. Here they frequented the willow trees surrounding a large, weed-choked pond. Most of the doves that I then saw were in pairs, and their mournful cooing was frequently heard. Although these birds were certainly behaving like breed-

ing adults rather than sickly or underdeveloped individuals, I looked in vain for a nest at this late date. However, the proprietor of the estate, Mr. C. H. Lankester, a naturalist well acquainted with the Costa Rican avifauna, told me that he had found Mourning Doves breeding there, although he had no written records. On 10 July 1963, Mr. Lankester brought me a dove, apparently adult, which had just been badly injured by a collision with an electric wire near San José.

Here in El General, Mourning Doves are rarely seen, but I have records of their presence from 26 February to 13 March 1939 and on 2 November 1943.

Near Quezaltenango, in the western highlands of Guatemala, I heard Mourning Doves cooing throughout the day of 24 July 1934. Some of the doves in a small flock that I then saw had short tails and were apparently not fully grown. Between 7,000 and 10,000 feet on the Sierra de Tecpam in the same country, where the Mourning Dove seemed to be only a migrant, it was last seen on 10 April 1933 and it returned on 19 November of the same year.

SUMMARY AND CONCLUSIONS

This paper presents observations on the nesting and other habits of 15 species of Central American pigeons. For two of these species, the Blue Ground-Dove and the Ruddy Quail-Dove, the information given here is supplementary to that contained in earlier papers. For another species whose life history has already been published, the Ruddy Ground-Dove, no more recent data are available. From all of the writer's observations on Central American pigeons, the following conclusions may be drawn:

Most Central American pigeons forage largely or wholly on the ground. These include species of *Zenaida*, *Scardafella*, *Columbigallina*, *Claravis*, *Leptotila*, and *Geotrygon*. As far as known, only several species of *Columba*, including the Scaled Pigeon, Short-billed Pigeon, and Band-tailed Pigeon, forage chiefly or wholly in trees and shrubs.

Most Central American pigeons live alone or in pairs. Concentrations of the ground feeders may occur in areas with abundant food, but coordinated flock movements are rarely seen. True flocking is found in the Band-tailed Pigeon, the most gregarious member of the family in Central America, and the species most in need of enforced legal protection.

Pigeons have longer breeding seasons than most other birds of the same region. In the valley of El General in Costa Rica, where these observations were chiefly made, most of the pigeons begin to nest early in the year, at the height of the dry season, when relatively few other birds are breeding. In several species, including the Ruddy Ground-Dove, Blue Ground-Dove, White-fronted Dove, and Rufous-naped Gray-chested Dove, egg laying begins in February (or rarely earlier) and is at its height in March and April. In May and June, when most other birds are nesting freely, few or no eggs of these pigeons are found. Laying is resumed in July and continues, on a reduced scale, into September. In the forest-dwelling Ruddy Quail-Dove, however, the peak of breeding comes in April, May, and June, as in most small birds of the region. The early nesting of most of the pigeons is probably associated with the abundance of seeds in bushy and weedy areas in the dry season.

Ground nesting was observed only in the Common Ground-Dove and the Plain-breasted Ground-Dove. The Scaled Pigeon, which lives high up in the forest, often builds its nest low in a neighboring second-growth thicket.

In nest building, one member of the pair stays on the nest to arrange the materials which the other collects and lays beside it. Whenever the sexes could be distinguished, the active

partner was the male and the stationary one the female. In the Scaled, Short-hilled, and Red-billed Pigeons, twigs or pieces of inflorescences are broken from trees, often with great effort; in the Ruddy Ground-Dove, Blue Ground-Dove, and White-fronted Dove, materials are gathered from the ground. Usually, perhaps always, a single piece is brought to the nest at a time, but this piece may be branched. Before being carried off, each piece is tested, often by shaking, and dropped if it proves unsatisfactory. Occasionally a female brings materials to the nest while her mate incubates the eggs, as has been seen in the Blue Ground-Dove and Ruddy Ground-Dove. Unlike the frail, shallow platforms built by most pigeons, the nests of the White-fronted Dove are often thick and substantial.

In nests of *Zenaida*, *Scardafella*, *Columbigallina*, *Claravis*, *Leptotila*, and *Geotrygon*, two eggs were nearly always found. As far as known, single eggs are consistently laid by Central American species of *Columba*, including some which in other regions produce sets of two.

The parents spend much time on the nest even before the first egg is laid, and this egg is (except in the Ruddy Quail-Dove) covered much in the interval before the laying of the second. After the routine of incubation is established, it follows, in all observed cases, the well-known pigeon pattern of two changeovers each day, with the male sitting, usually continuously, through the middle of the day. The chief variations noticed were in the times of the changeovers and the length of the male's diurnal sessions, which in the several species studied varied from about 4 to 9 hours.

The following incubation periods were determined: Ruddy Quail-Dove, 11 days; Ruddy Ground-Dove, 12-13 days; Blue Ground-Dove, 14-15 days; White-fronted Dove, 14 days.

Pigeons differ from most altricial birds in that the number of times the young are fed may greatly exceed the number of parental visits to the nest—a consequence of the parents' ability to secrete food ("pigeon's milk"), which they at intervals regurgitate to the nestlings during their first few days. As the nestlings grow older, the meals become fewer but each lasts longer and is apparently more copious. Day-old nestlings were fed 28 times in a day in the Blue Ground-Dove and 22 times in the Ruddy Quail-Dove. Older nestlings were fed eight times per day in the Blue Ground-Dove, three times in the Ruddy Quail-Dove, two or three times in the Gray-chested Dove. Sightless newly hatched nestlings are usually fed singly; but after they can see, the two young place their bills in the parent's mouth from opposite sides and are fed simultaneously.

White-fronted Doves spend much time brooding feathered nestlings ready to leave the nest, and sometimes Ruddy Ground-Doves do the same. Blue Ground-Doves and Ruddy Quail-Doves leave their nestlings exposed much of the time, even before they are feathered.

The attention given to nest sanitation varies greatly in the family. White-fronted Doves and Ruddy Quail-Doves keep their nests clean at all times. Scaled Pigeons and Red-billed Pigeons clean the nest for some days after the young hatch but later neglect to do so. Ruddy Ground-Doves and Blue Ground-Doves give little attention to sanitation, and their nests soon become foul. Those pigeons which clean their nests eat the nestlings' droppings, sometimes just before feeding the young. This raises the question of whether the nestlings' excreta are fed back to them.

While sitting on the nest, pigeons carefully weigh the threat presented by an approaching object, and leave only if it appears dangerous and likely to discover the nest. Then the parent may give a distraction display. Such performances were observed in the Ruddy Ground-Dove, Rufous-naped Gray-chested Dove, Ruddy Quail-Dove, White-fronted Dove, and Red-billed Pigeon. In the last two species, the displays were especially vigorous and prolonged. When disturbed, nestling Scaled Pigeons and Red-billed Pigeons give an elaborate intimidation display, in which bill clacking is a prominent feature.

The following nestling periods were determined: Ruddy Quail-Dove, 10 days; Ruddy

Ground-Dove, 12-14 days; Blue Ground-Dove, 13 or 14 days; White-fronted Dove, 15-16 days. If undisturbed, the young stay in the nest until they can fly well.

In El General, at least two broods are reared, sometimes in the same nest, by the Ruddy Quail-Dove and the Ruddy Ground-Dove, and doubtless by other species.

Evidence of the breeding of the Mourning Dove in Costa Rica is given.

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